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OR 1,345,700

J. L. ROUTIN.

ANTI-AIRCRAFT GUNFIRE CONTROL SYSTEM.

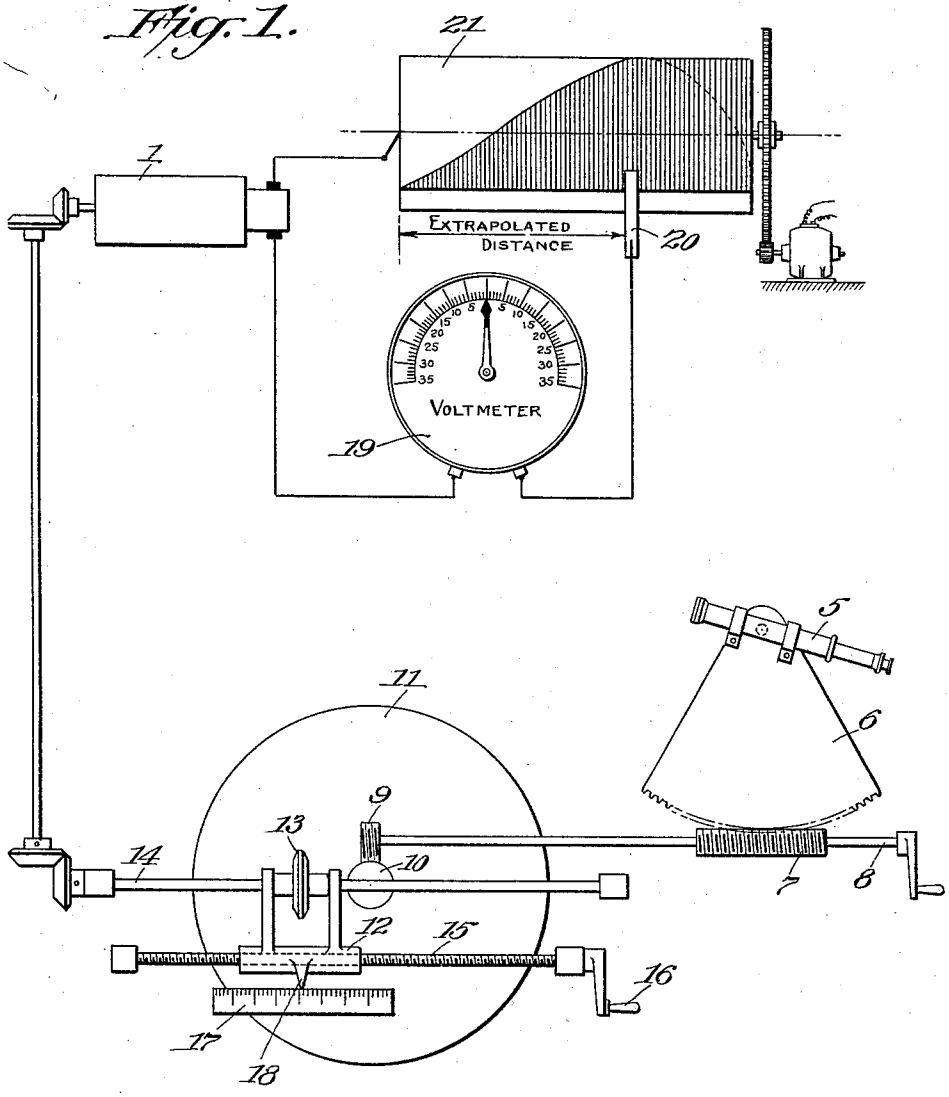
APPLICATION FILED JULY 26, 1917.

1,345,700.

Patented July 6, 1920.

2 SHEETS—SHEET 1.

Fig. 1.



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2 SHEETS—SHEET 2.

Fig. 2.

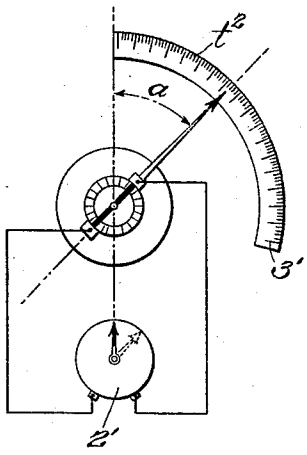


Fig. 3.

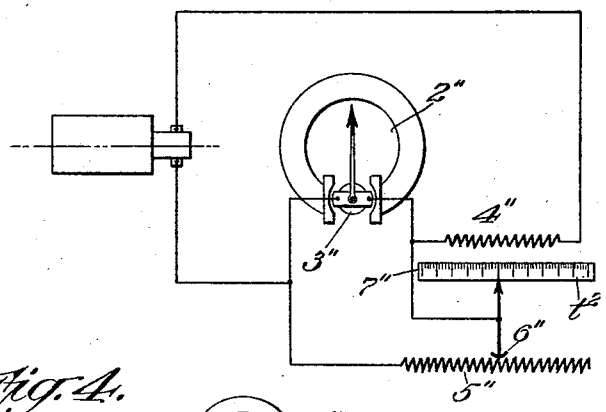


Fig. 4.

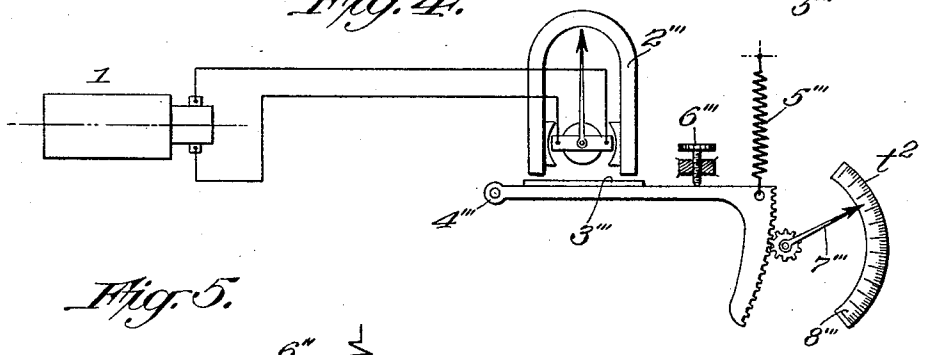
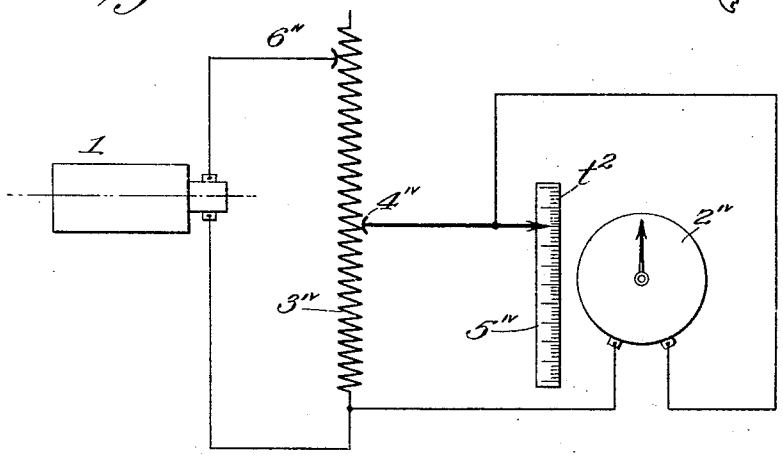


Fig. 5.



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UNITED STATES PATENT OFFICE.

JOSEPH LOUIS ROUTIN, OF PARIS, FRANCE.

ANTI-AIRCRAFT GUNFIRE-CONTROL SYSTEM.

1,345,700. Specification of Letters Patent. Patented July 6, 1920.

Application filed July 26, 1917. Serial No. 182,981.

To all whom it may concern:

Be it known that I, JOSEPH LOUIS ROUTIN, a citizen of the French Republic, residing at 2 Rue Olchanski, Paris, France, have invented new and useful Anti-Aircraft Gunfire-Control Systems, which is fully set forth in the following specification.

The present invention relates to improvements in tachychronometrical apparatus such as described in my application for patent Serial No. 182,311, filed July 23, 1917, now Patent No. 1,345,697, dated July 6, 1920, and has for its object to provide a particular form of apparatus of the above kind which permits of the direct determination of the product of either the azimuthal or zenithal velocity of an aerial target by the time of flight of the projectile without making any calculations.

In regulating the firing of anti-aircraft guns, it is necessary to apply a correction to the vertical and lateral directions of aim in order to compensate for the change of position of the aerial target during the time of flight of the projectile. This correction requires the determining of the angular zenithal and azimuthal velocities of the target and a knowledge of the time of flight of the projectile for an extrapolated or estimated distance of the target. Representing the zenithal angle by α, ω the azimuthal angle, and t_2 the time of flight of the projectile as in the above application, then the zenithal and azimuthal velocities will be $\frac{d\alpha}{dt}$ and $\frac{d\omega}{dt}$ respectively, and the correction sought will be the products $t_2\frac{d\alpha}{dt}$ and $t_2\frac{d\omega}{dt}$.

In the following it will be assumed, for instance, that one has to determine the product of the azimuthal speed by the time of flight, which will be designated respectively, as in the principal application, by $\frac{d\omega}{dt}$ and t_2.

In the accompanying drawings Figure 1 is a diagrammatic view illustrating one arrangement of the apparatus embodying my invention.

Figs. 2 to 5 similarly illustrate other arrangements for accomplishing the same object.

Referring to Fig. 1 of the drawings, 1 designates a continuous current generator adapted to be driven at a speed proportional to $\frac{d\omega}{dt}$. For this purpose any suitable means may be employed. As illustrated the sighting telescope 5 is mounted on a sector 6 which engages a worm 7 on a hand-operated shaft 8 on which is fast a worm gear 9 meshing with a pinion 10 on the axis of a disk 11. A frame 12 supports a friction wheel 13 having a splined connection with a shaft 14. The frame is capable of longitudinal adjustment on a screw shaft 15 by turning a handle 16. The position of the frame may be indicated by a scale 17 and pointer 18. Shaft 9 is adapted to transmit its rotation to the armature shaft of the generator 1 as indicated.

19 is a voltmeter having the properties of a ballistic galvanometer and is graduated with a double scale allowing of reading in either direction of rotation of the generator 1. One terminal of the voltmeter is connected to the generator, the other terminal is connected to a longitudinally adjustable brush 20 bearing on a drum 21 driven at constant speed such as 5 to 10 revolutions per second, and having a helicoidal projecting surface of contact on which brush 20 bears. Distances measured along the generating line of the cylinder are made proportional to the predicted or extrapolated distances to the target while the time during which the brush is in contact with the conducting portion of the cylinder is made proportional to the time of flight t_2.

The operation of the apparatus is as follows. The telescope 5 is made to follow in azimuth the direction of the target by turning crank shaft 8. The rotation of this shaft is imparted to the motor-driven shaft through gears 9, 10, disk 11, friction wheel 13 and shaft 14. The speed of the generator and therefore the voltage generated is proportional to the azimuthal speed $\frac{d\omega}{dt}$. The readings of the ballistic voltmeter are proportional to the amount of current in the circuit and this in turn depends upon the ratio of the conducting to the non-conductive segments on drum 3. This ratio may be expressed as $k_2\ t_2$ where k_2 is a function of time only. Therefore if there is a unit

of E. M. F. in the circuit the ballistic voltmeter will read $k_2\ t_2$ a product which is wholly determined by the position of the brush 4 movable parallel with the axis of the drum or, in other words, to the value of time t_2. The voltage is, as shown above, proportional to $\frac{d\omega}{dt}$ and therefore the voltmeter will read the product $k_2 t_2 \frac{d\omega}{dt}$ or $kk_2 t_2 \frac{d\omega}{dt}$ where k is a constant depending upon the physical dimensions of the system and determining the gradations of the voltmeter scale.

The system is equally applicable for directly reading on the voltmeter the product of the zenithal velocity $\frac{d\alpha}{dt}$ by the time of flight t_2.

Fig. 2 illustrates another embodiment of the invention in which the brushes of the direct-current generator are adapted to be displaced through an angle α opposite a fixed sector 3′ graduated in functions of t_2 so that for a determined speed of rotation the tension read on the voltmeter may be proportioned to t_2. The amount of compensation of the apparatus would then be obtained by displacing longitudinally in the direction of its axis the armature coil in relation to its inductor.

Fig. 3 illustrates a second modification in which a fixed resistance 4″ is in series with the voltmeter and a variable resistance 5″ in parallel with frame 3″ of the voltmeter. A contact 6″ is moved in front of a scale 7″ graduated in functions of t_2 so that for a determined speed of rotation the tension read on voltmeter 2 may be proportional to t_2. The amount of compensation is obtained by displacing longitudinally the armature coil in relation to the inductor as in the first modification.

Fig. 4 illustrates a third modification in which the magnetic flux of the voltmeter 2″ is modified, for instance, by displacing a magnetic member 3‴ movable around an axis 4‴ by means of a screw 6‴ against the tension of a spring 5‴. The angle of displacement is read on a scale 8‴ graduated in functions of time t_2 by means of an index y''' having a pinion meshing with a rack on member 3‴. For a determined speed of rotation, the tension read on voltmeter 2‴ is proportional to t_2. The amount of compensation is obtained as in the preceding examples.

Fig. 5 illustrates a fourth modification in which 3^{iv} is a fixed resistance connected to the terminals of the generator. A regulatable tension is taken off resistance 3^{iv} by displacing the movable key 4^{iv} over a scale 5^{iv} graduated in functions of t_2 so that for a determined speed of rotation the tension read on the voltmeter is proportional to t_2. The amount of compensation would be obtained as above. The compensation could also be obtained by displacing contact 6^{iv}.

What is claimed is:

1. In apparatus for determining the angular speed of an aerial target by the time of flight of the projectile for regulating the firing of anti-aircraft guns, means for generating an electromotive force proportional to the angular speed of the target, a voltmeter in circuit therewith having the characteristics of a ballistic galvanometer and means associated with the circuit for controlling the application of said pressure to the voltmeter in proportion to the time of flight of the projectile for rendering the voltmeter readings a function of the product of speed of the target and time of flight.

2. In apparatus for determining the angular speed of an aerial target by the time of flight of the projectile for regulating the firing of anti-aircraft guns, means for generating an electromotive force proportional to the angular speed of the target, a voltmeter in circuit therewith having the characteristics of a ballistic galvanometer and means associated with the circuit for controlling the application of said pressure to the voltmeter in proportion to the time of flight of the projectile for rendering the voltmeter reading a function of the product of speed of the target and time of flight, said means comprising a constant speed cylinder having a surface partly conducting and partly non-conducting the ratio of the two depending on the time of flight of the projectile and a brush adjustable lengthwise of the cylinder and contacting therewith for closing the circuit through said conducting portion.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

JOSEPH LOUIS ROUTIN.

Witnesses:
HENRI MONIN,
CHAS. P. PRESSLY.